LA-UR-21-30422

Title:	RCT 4th Qtr Continuing Training- Radiological Surveys
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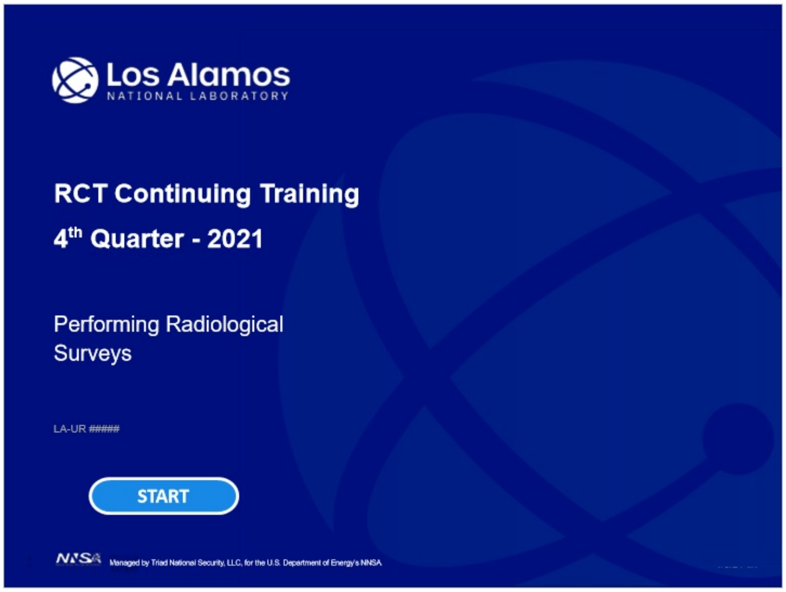
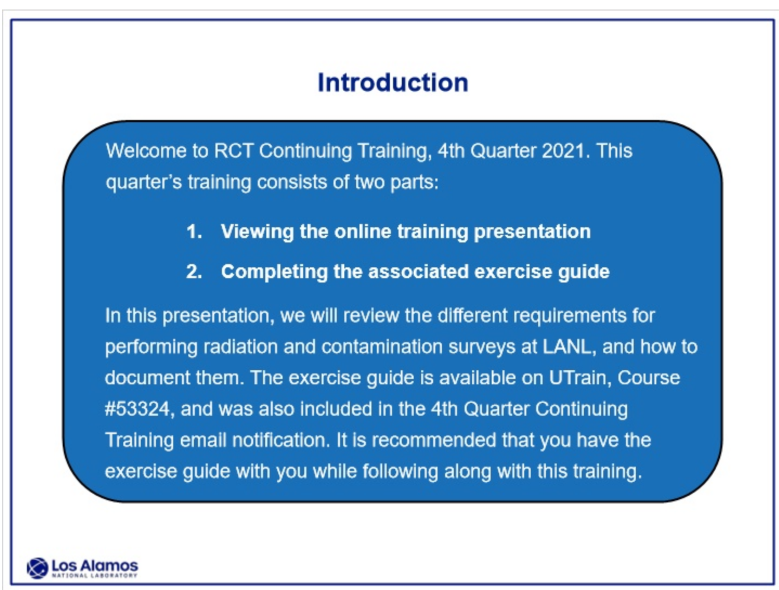
Intended for:	RCT Continuing Training
Issued:	2021-10-20

1. RCT Continuing Training 4th Quarter 2021

1.1 RCT Continuing Training

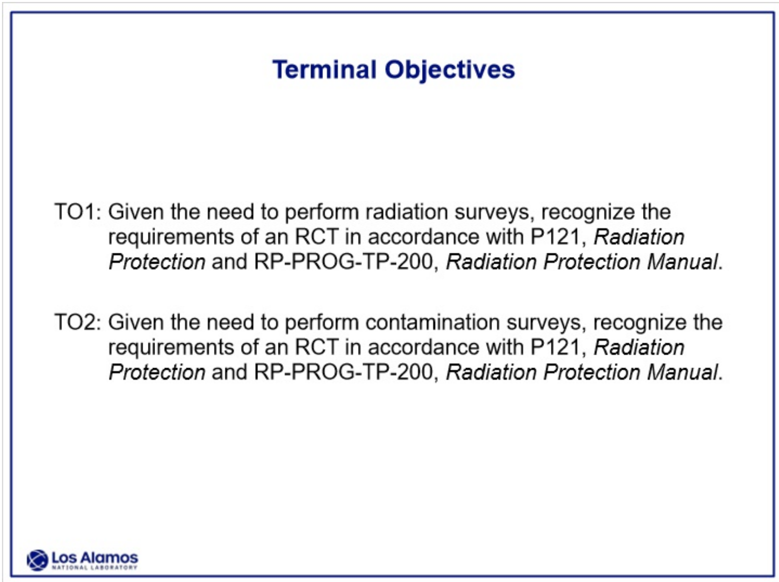


1.2 Introduction

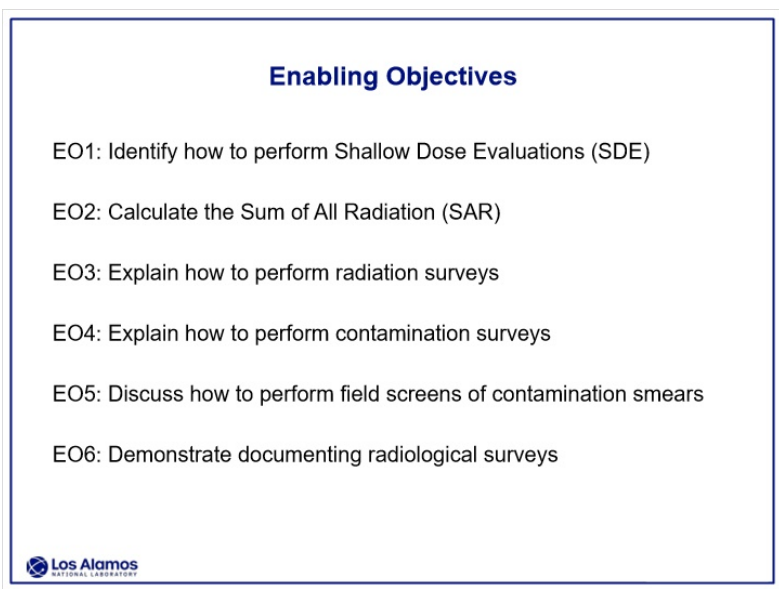


Notes:

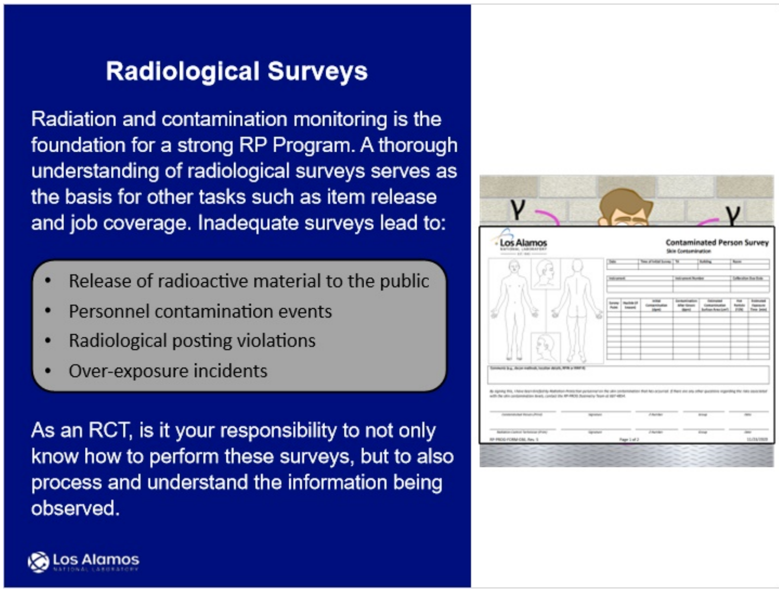
1.3 Terminal Objectives



1.4 Enabling Objectives

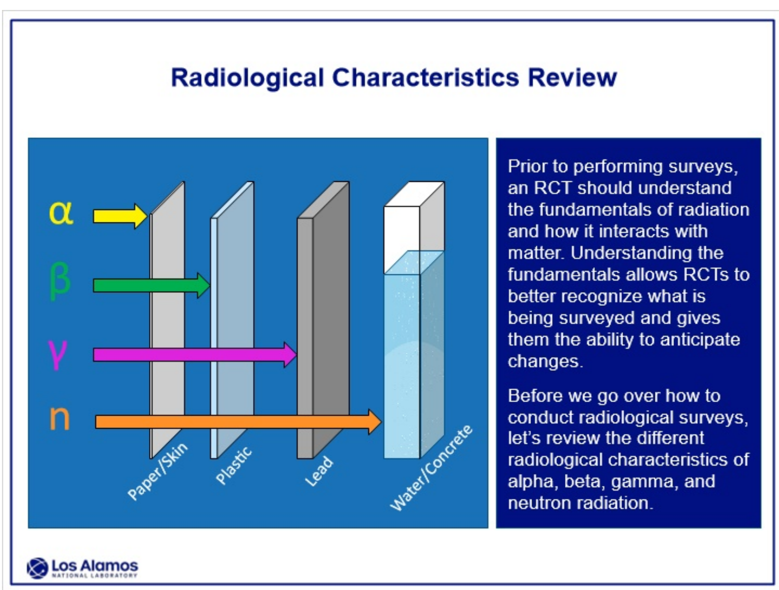


1.5 Radiological Surveys

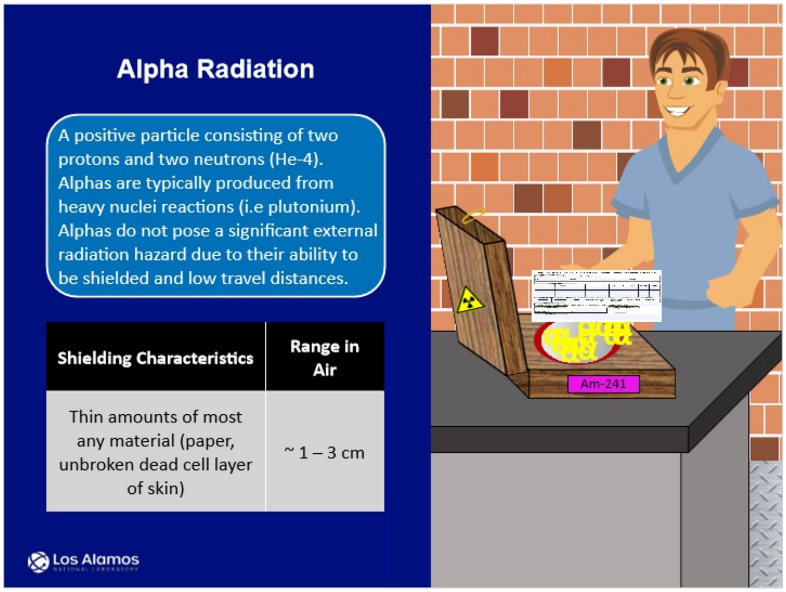


Notes:

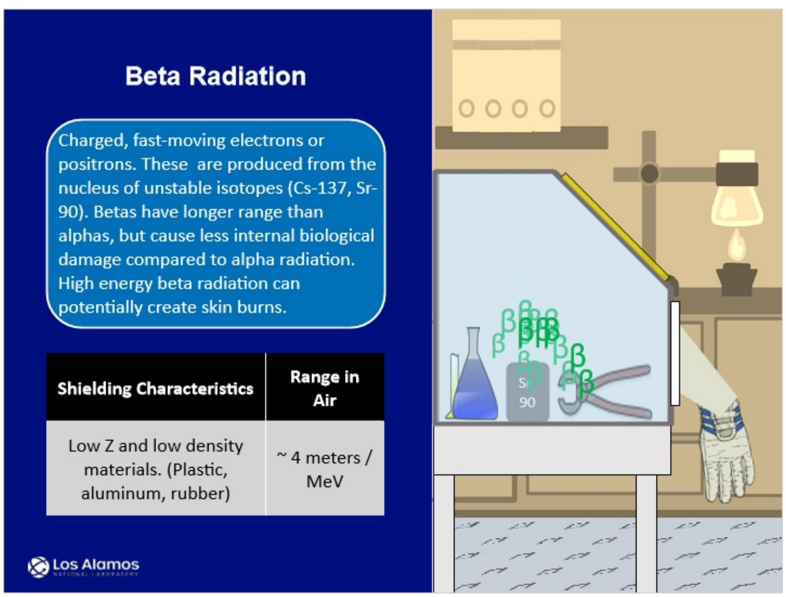
1.6 Radiological Characteristics Review



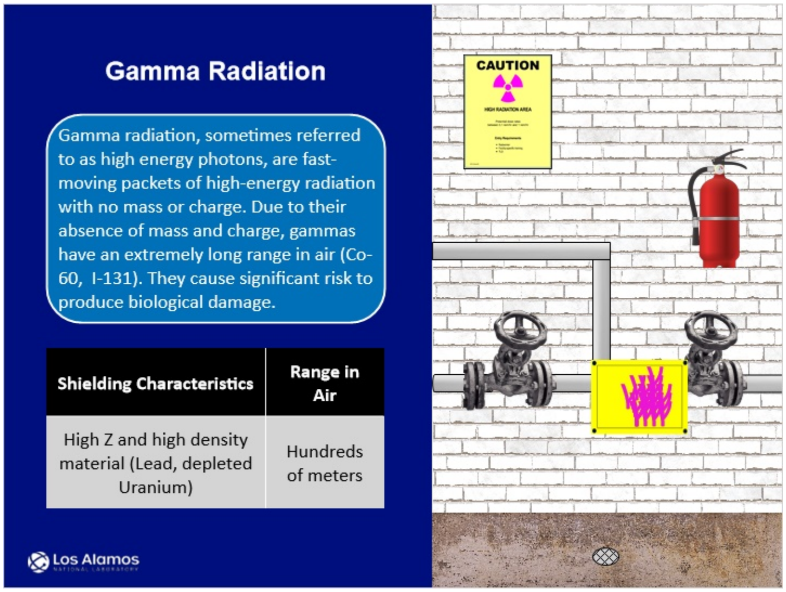
1.7 Alpha Radiation



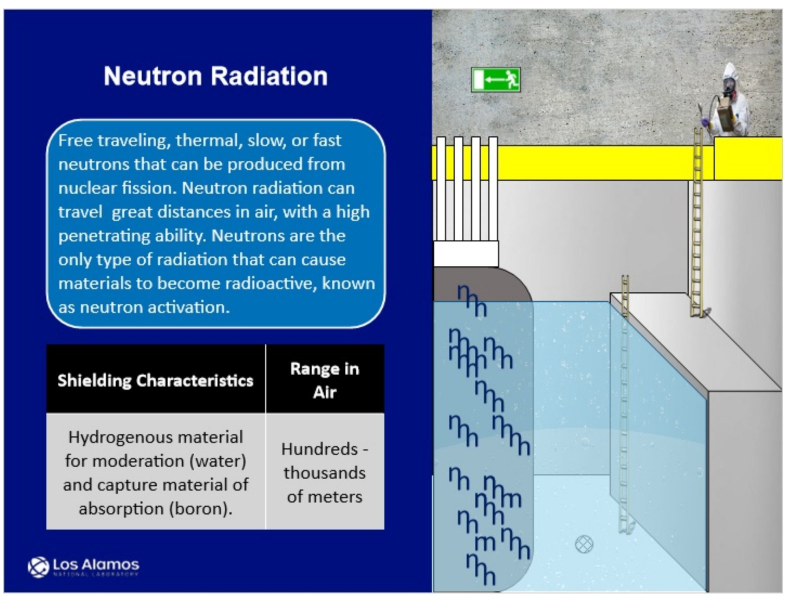
1.8 Beta Radiation



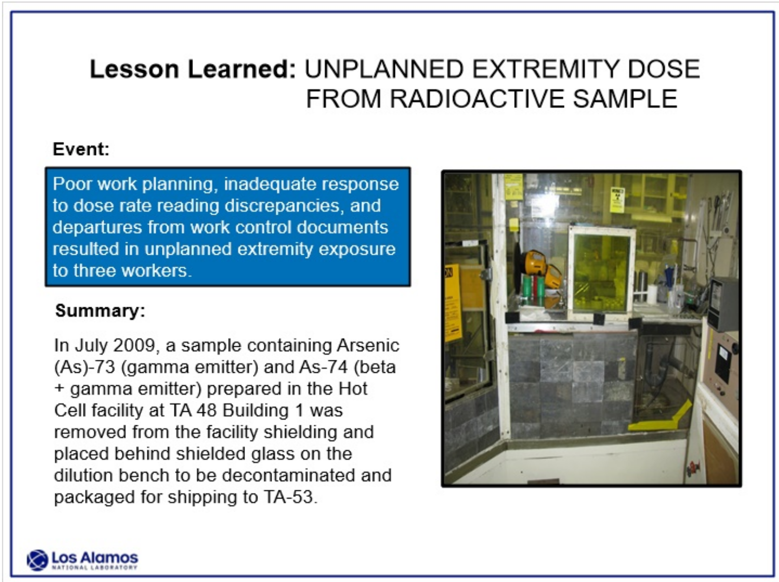
1.9 Gamma Radiation



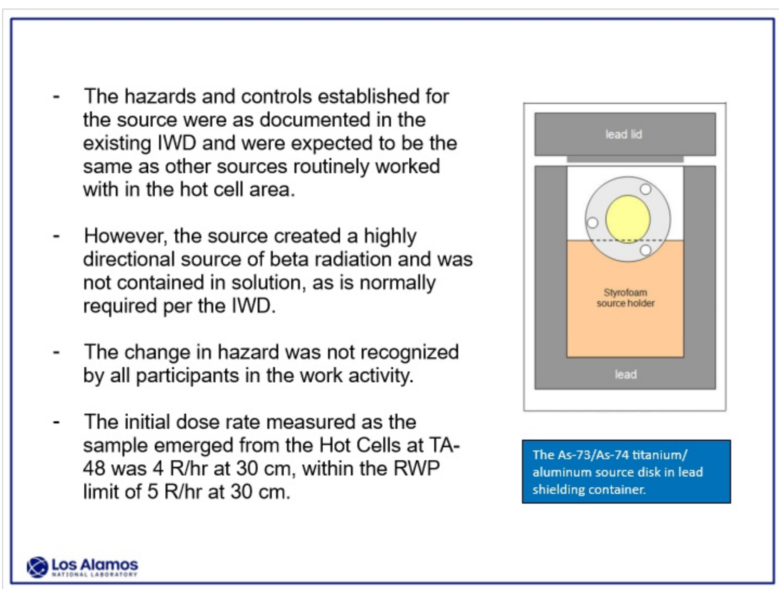
1.10 Neutron Radiation



1.11 Lesson Learned Summary

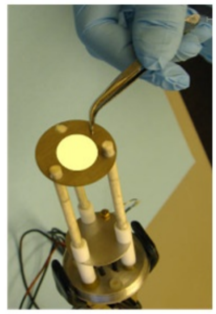


1.12 Summary 2 of 4



1.13 Summary 3 of 4

- The lead chemist placed it in the lead shipping pig, where another dose rate reading at the mouth of the pig indicated 30 R/hr at 30 cm.
- Although the sample was packaged safely for shipping this dose rate discrepancy was not fully documented.
- The sample was shipped to TA-53 where the container and the lead pig holding the sample were surveyed for dose rate and contamination.
- The contamination survey was negative and the external dose rate survey with the pig lid open indicated 5 R/hr beta/gamma and 1 R/hr gamma at 30 cm.



Using tweezers to position As-73/As-74 titanium/aluminum source disk onto the three posts.

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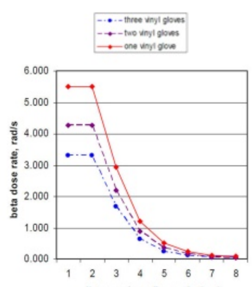
1.14 Summary 4 of 4

- The gamma dose rate was within the RWP limits at TA-53 (beta dose rate limit was not defined) and the work team proceeded with mounting the sample in the ion chamber.
- As the mounting process neared completion, another dose rate measurement indicated 30 R/hr at 30 cm.
- The work team members agreed that to make the situation safe while minimizing additional exposure, the mounting should be completed and the ion chamber cover put in place.
- Two researchers received doses to their extremities while installing the sample and assembling the ion chamber. A subsequent dose assessment indicated beta doses of 26 rem and 19 rem to the extremities.



Dose rate to index finger while holding source

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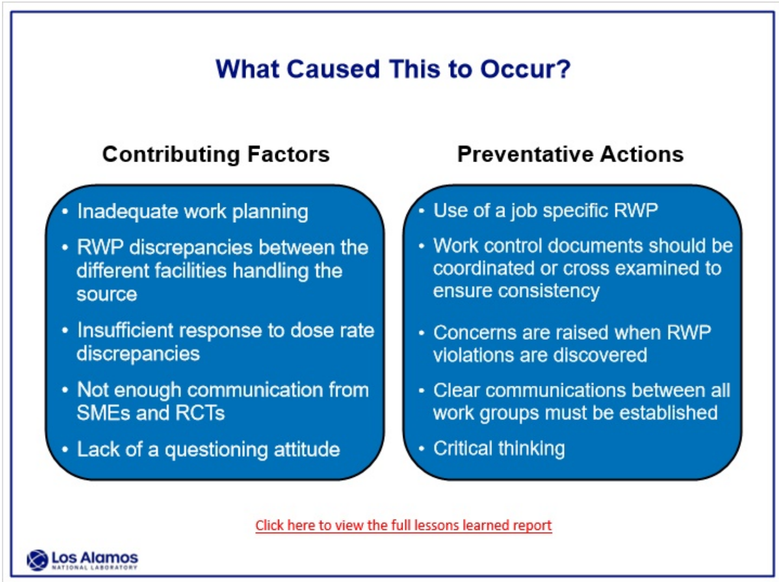
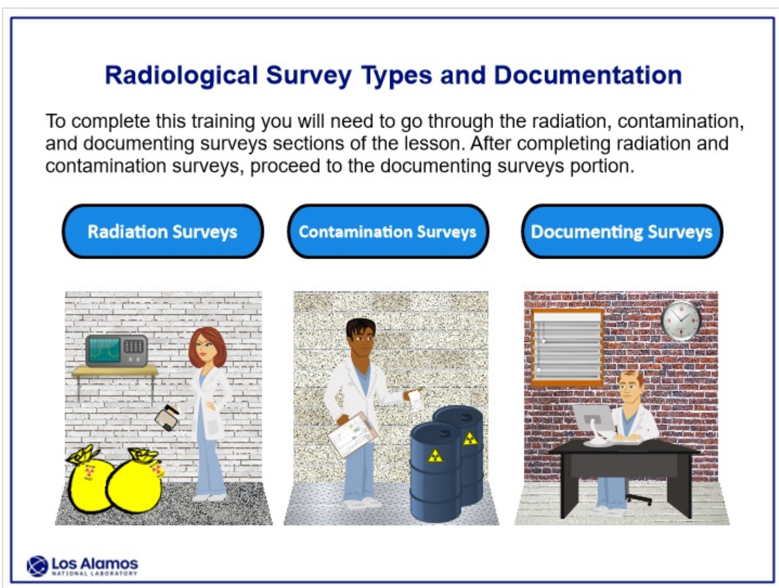
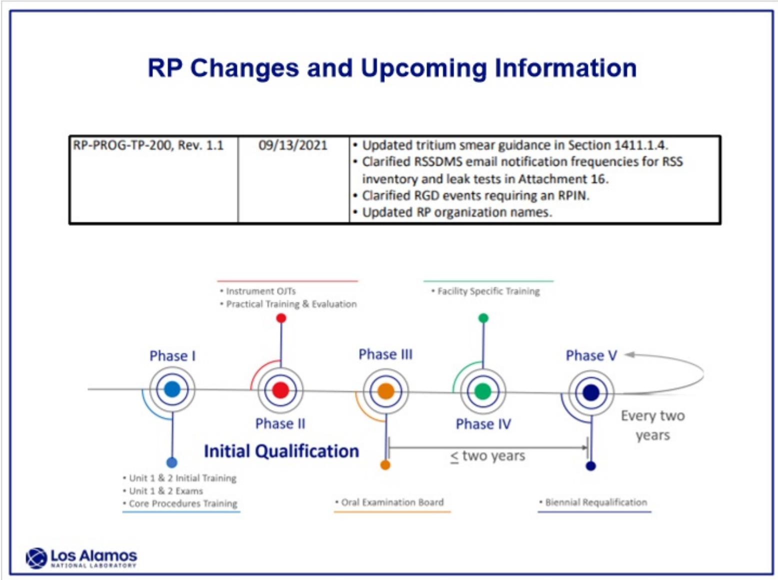
1.15 What Caused This to Occur?



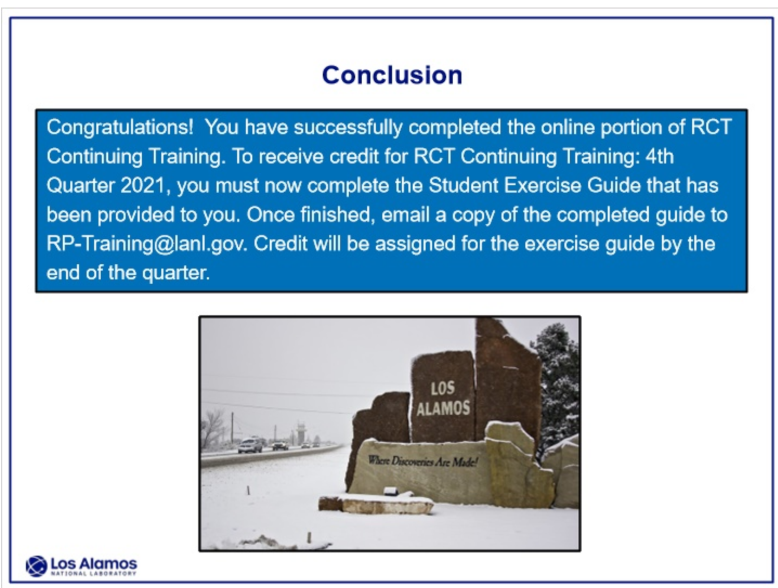
1.16 Radiological Survey Types and Documentation



1.17 RP Changes and Upcoming Information

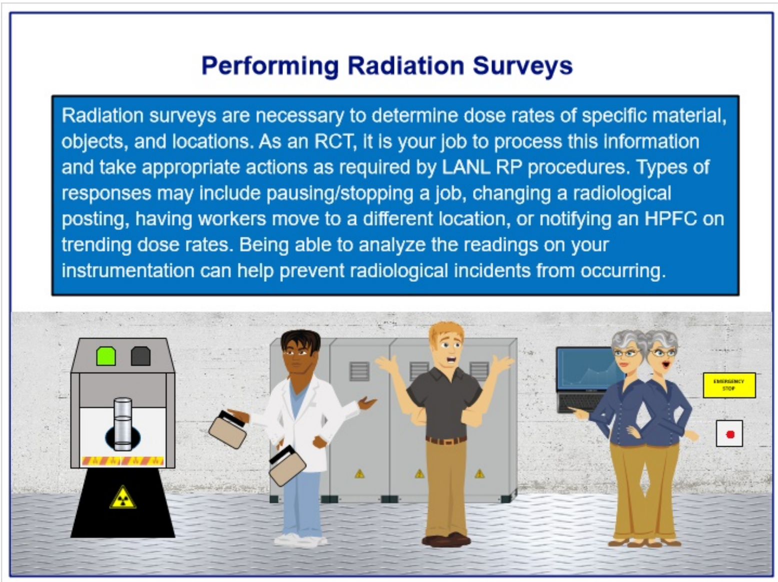


1.18 Conclusion

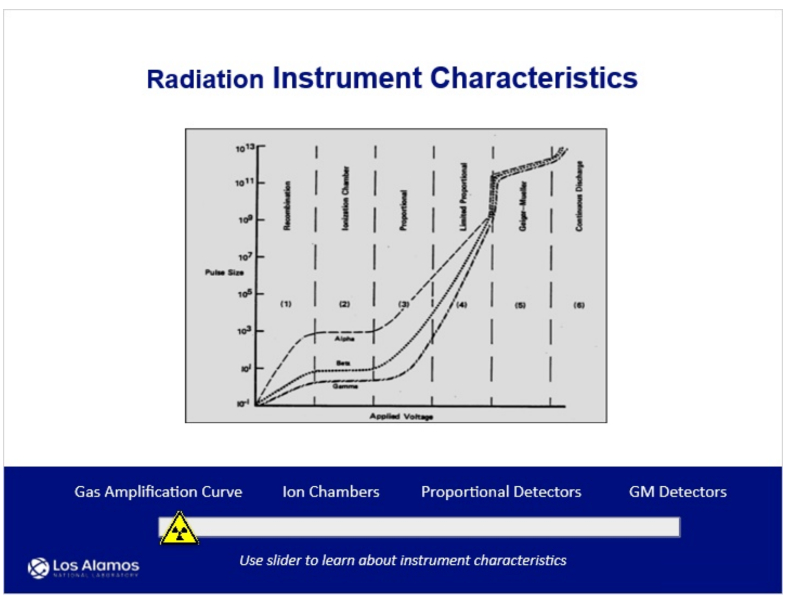


2. Radiation Surveys

2.1 Performing Radiation Surveys

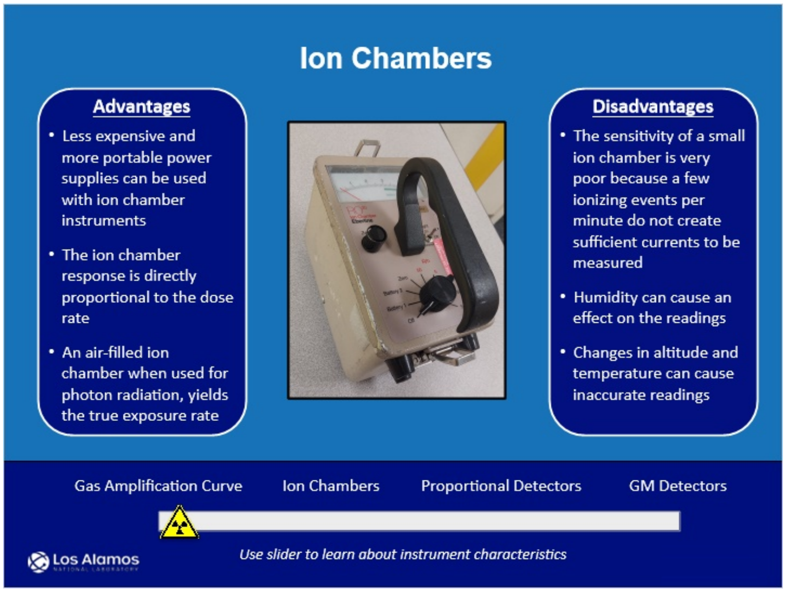


2.2 Instrument Characteristics

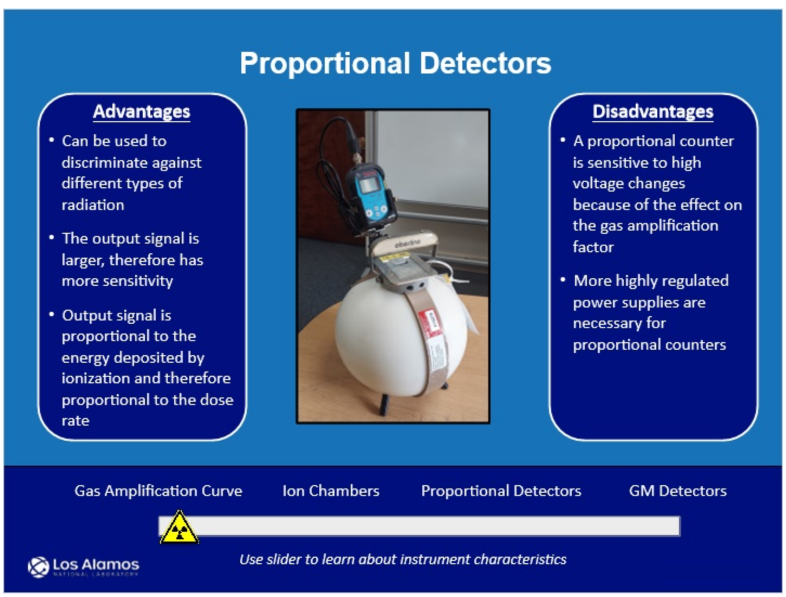


Notes:

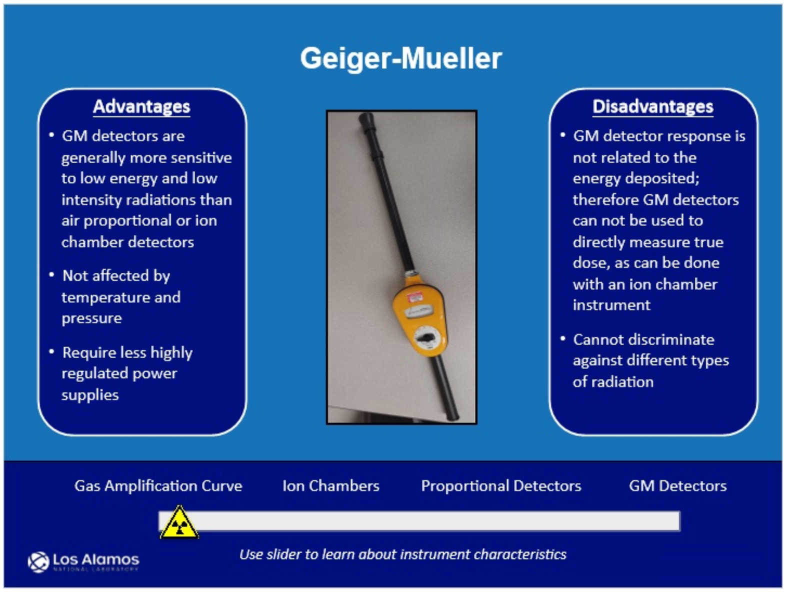
Ion Chamber (Slide Layer)



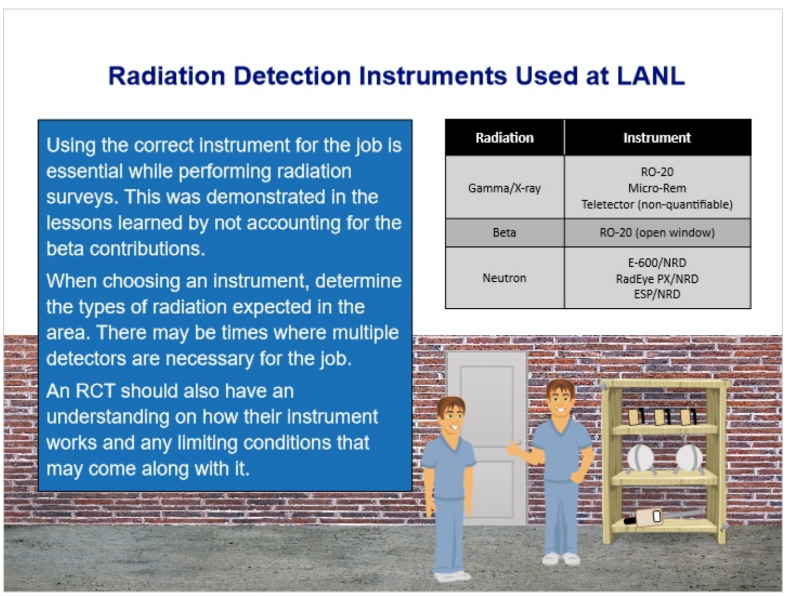
Proportional (Slide Layer)



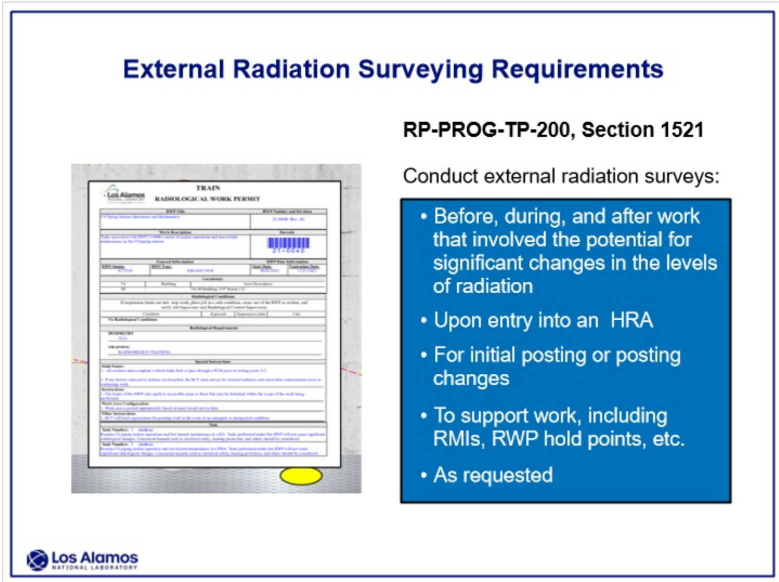
Geiger Mueller (Slide Layer)



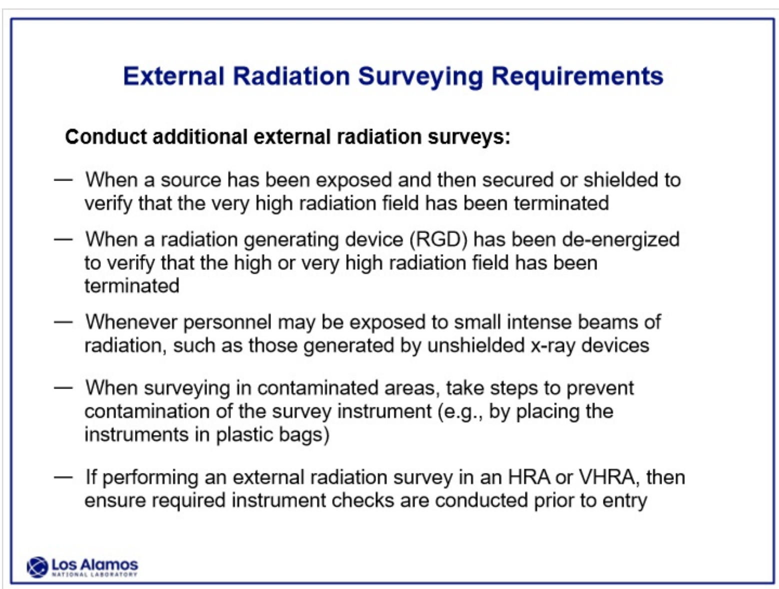
2.3 Instruments Used at LANL



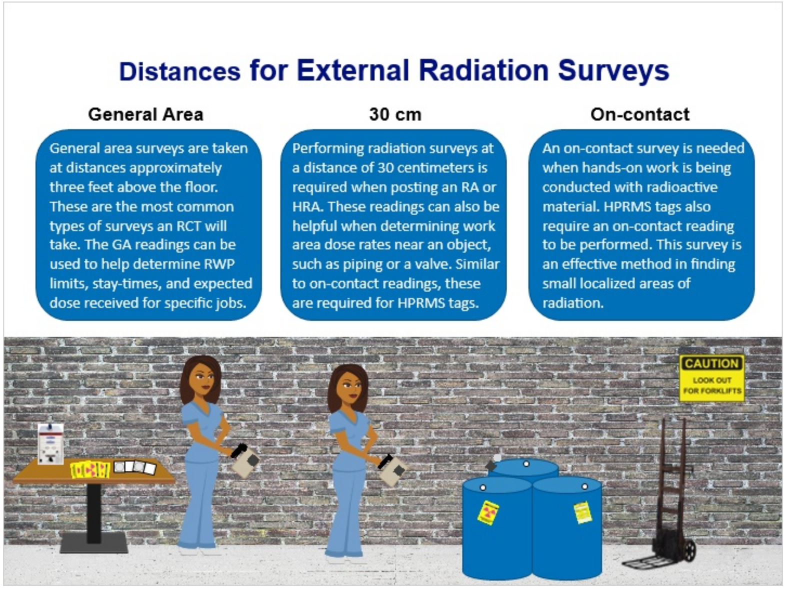
2.4 External Radiation Surveying Requirements



2.5 External Radiation Surveying Requirements continued



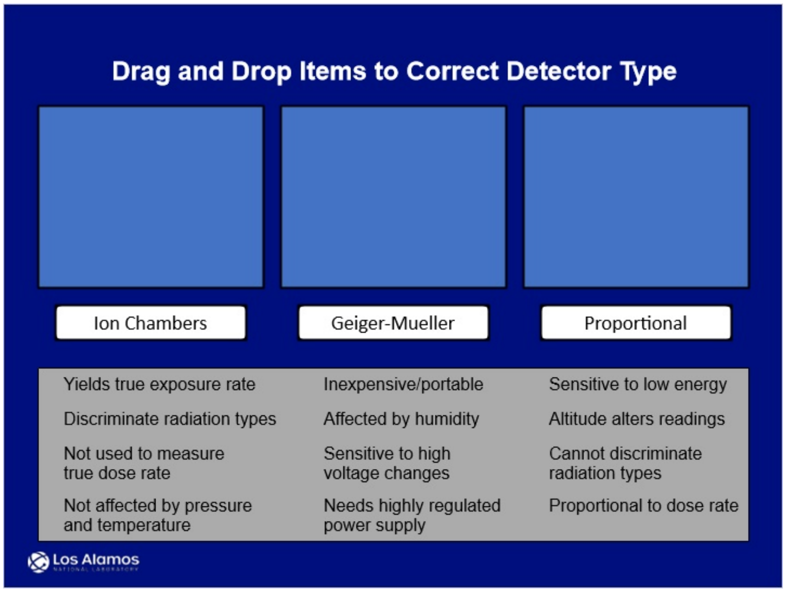
2.6 Distances for External Radiation Surveys



Notes:

2.7 Knowledge Check

(Drag and Drop, 0 points, 2 attempts permitted)



Drag Item	Drop Target
Inexpensive/portable	IC
Affected by humidity	IC
Altitude alters readings	IC
Yields true exposure rate	IC
Discriminate radiation types	Prop
Needs highly regulated power supply	Prop
Not affected by pressure and temperature	GM
Sensitive to high voltage changes	Prop
Proportional to dose rate	Prop
Sensitive to low energy	GM
Cannot discriminate radiation types	GM
Not used to measure true dose rate	GM

Drag and drop properties
Return item to start point if dropped outside the correct drop target
Snap dropped items to drop target (Tile)
Delay item drop states until interaction is submitted

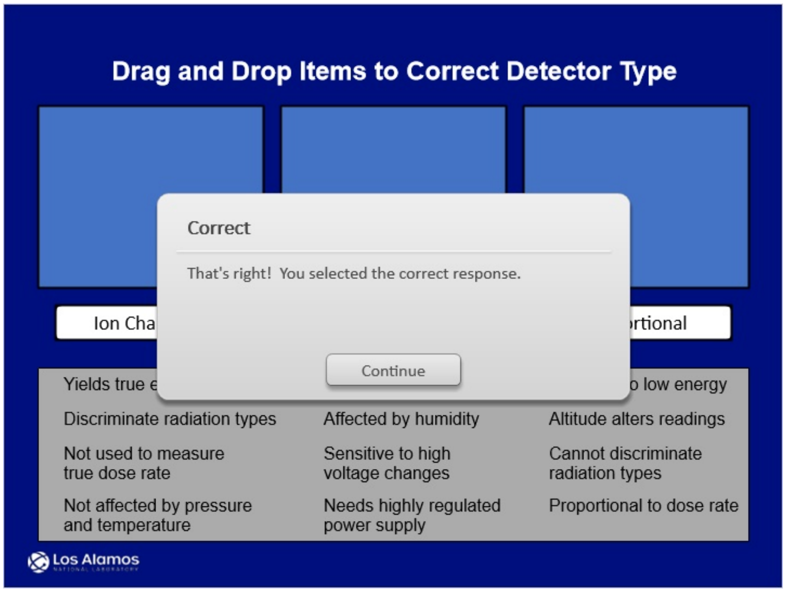
Feedback when correct:

That's right! You selected the correct response.

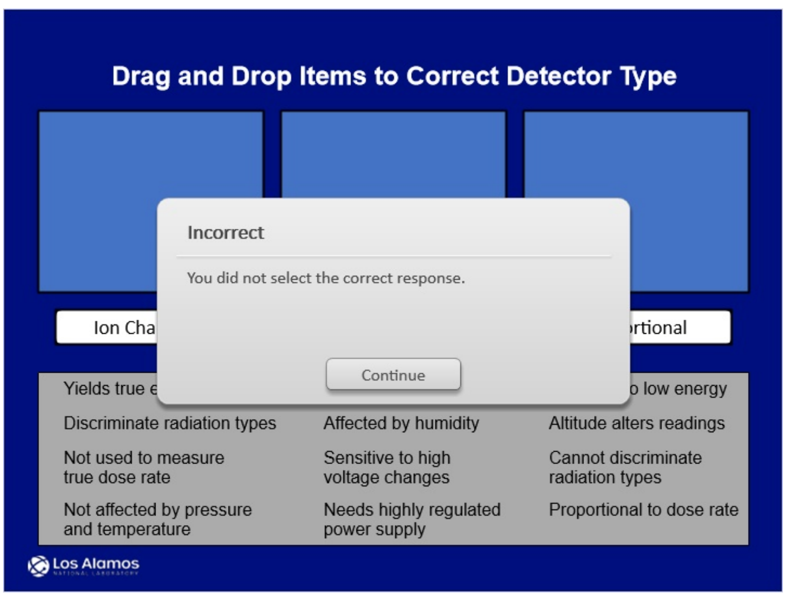
Feedback when incorrect:

You did not select the correct response.

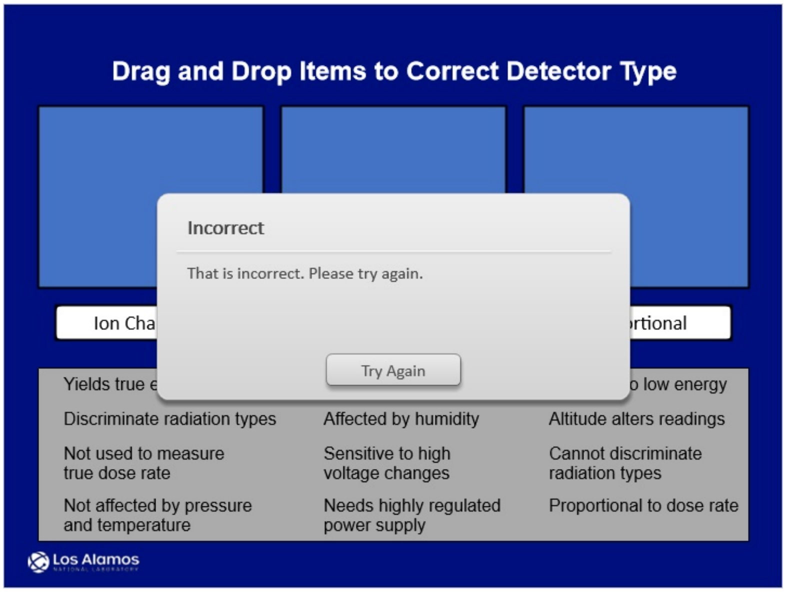
Correct (Slide Layer)



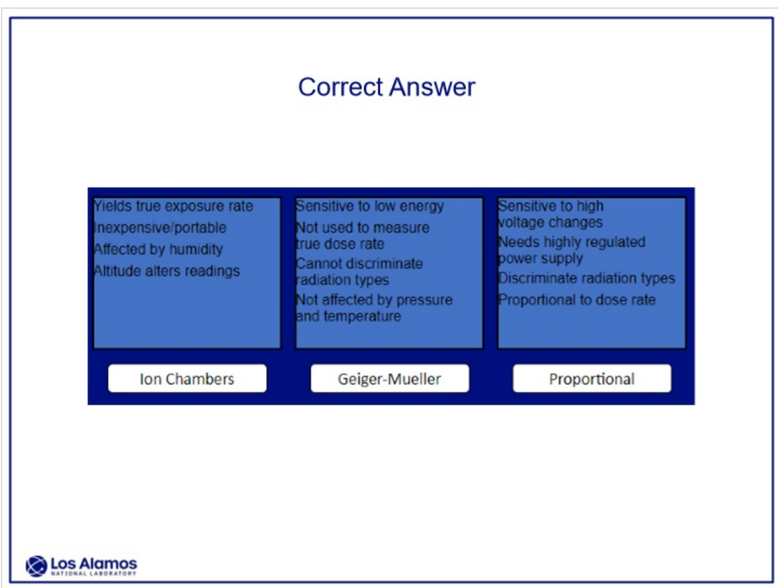
Incorrect (Slide Layer)



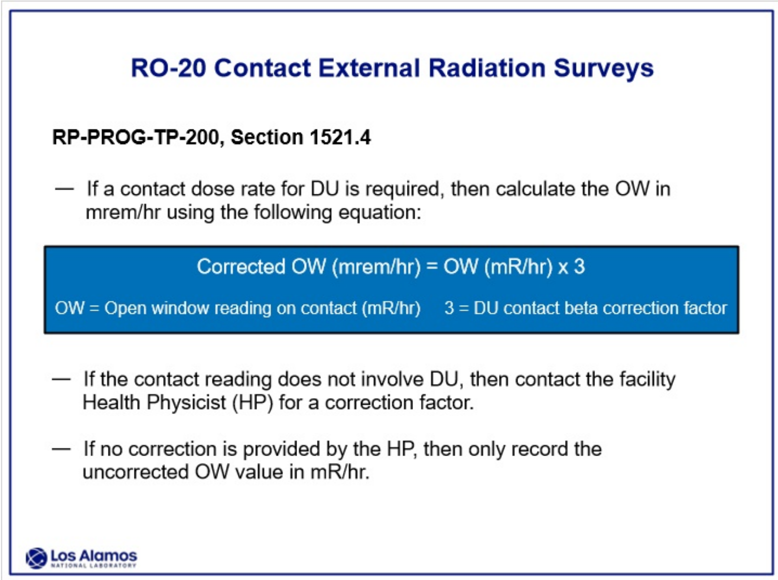
Try Again (Slide Layer)



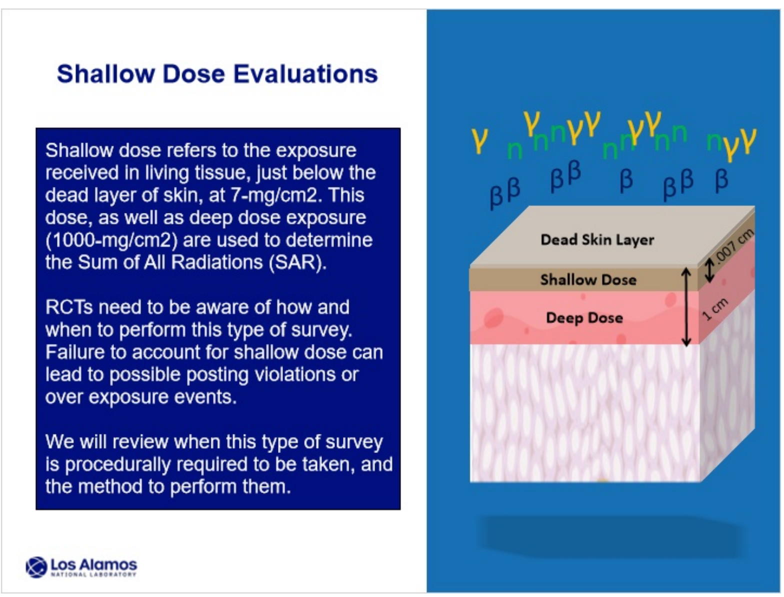
2.8 Knowledge Check Answer



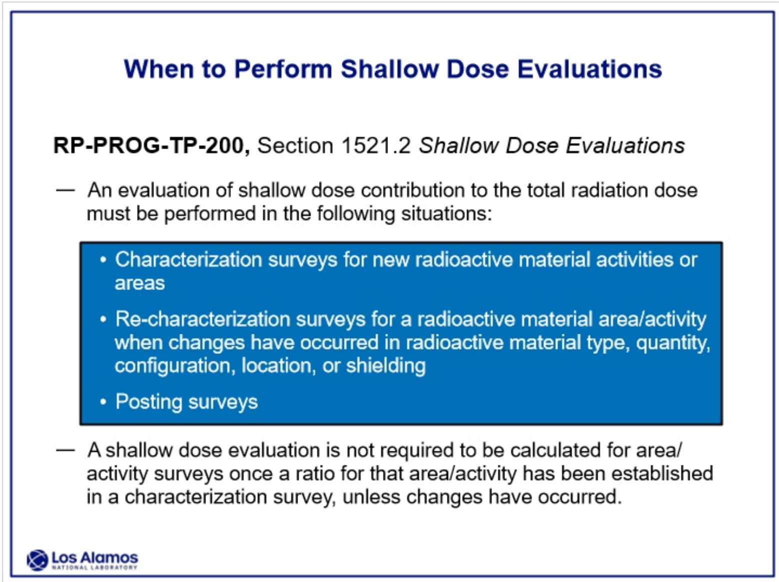
2.9 RO-20 Contact External Radiation Surveys



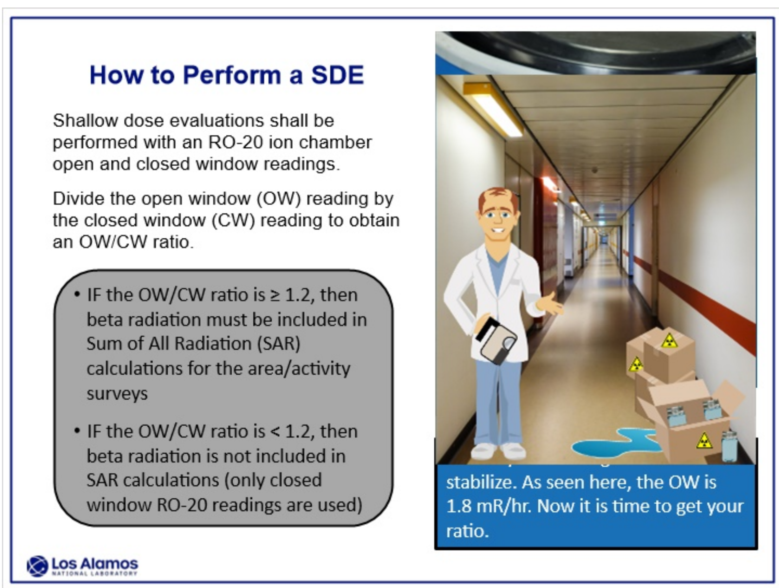
2.10 Shallow Dose Evaluations



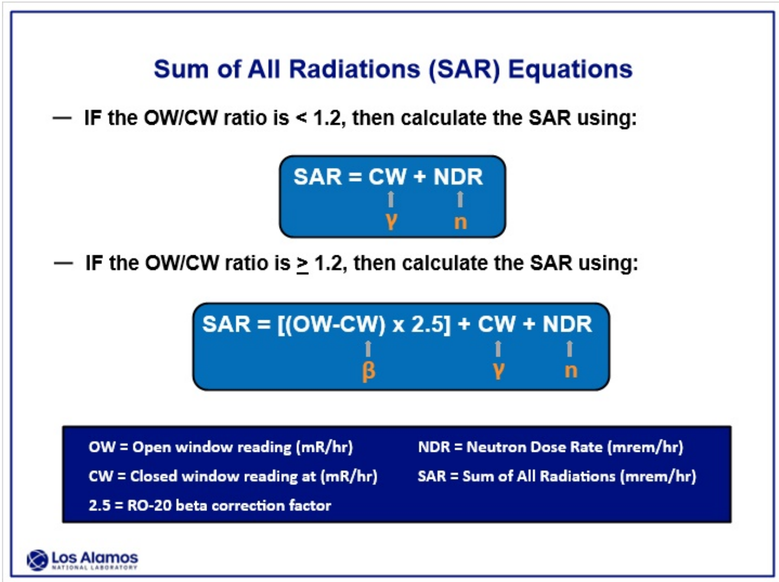
2.11 When to Perform SDEs



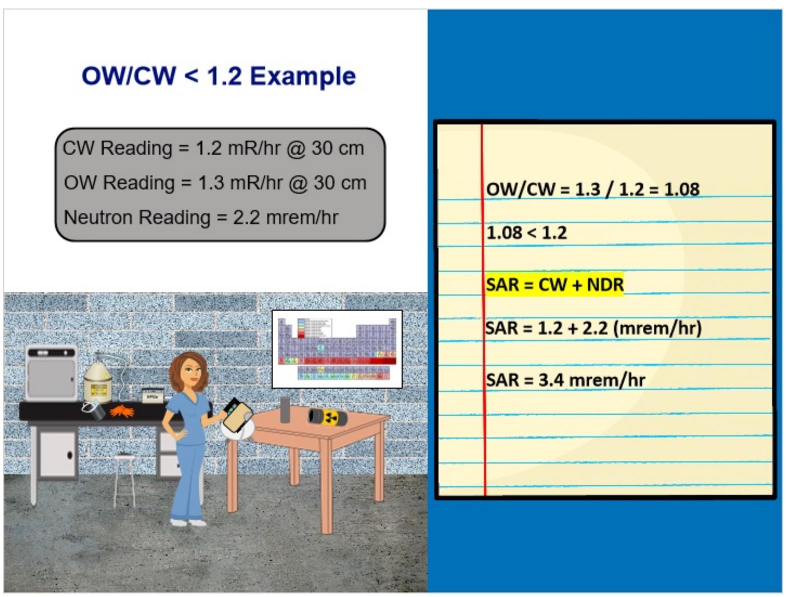
2.12 How to Perform a SDE



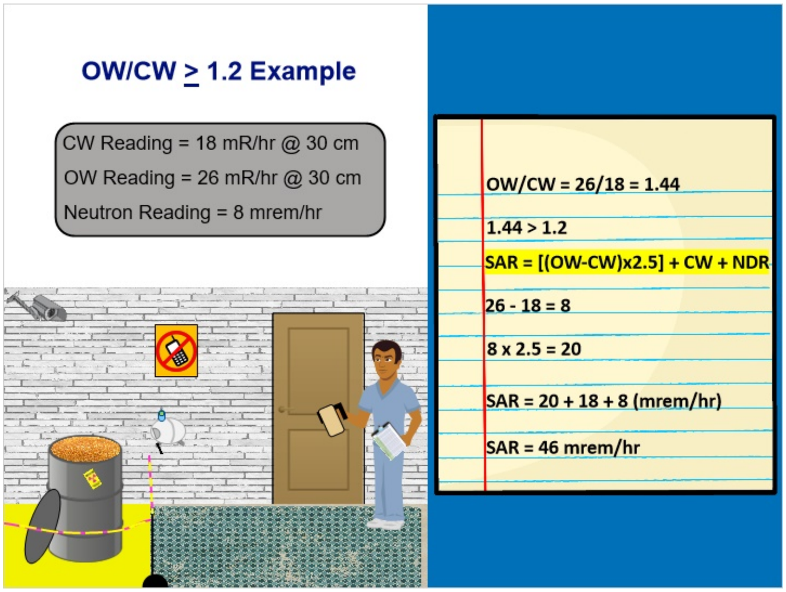
2.13 SAR Equations



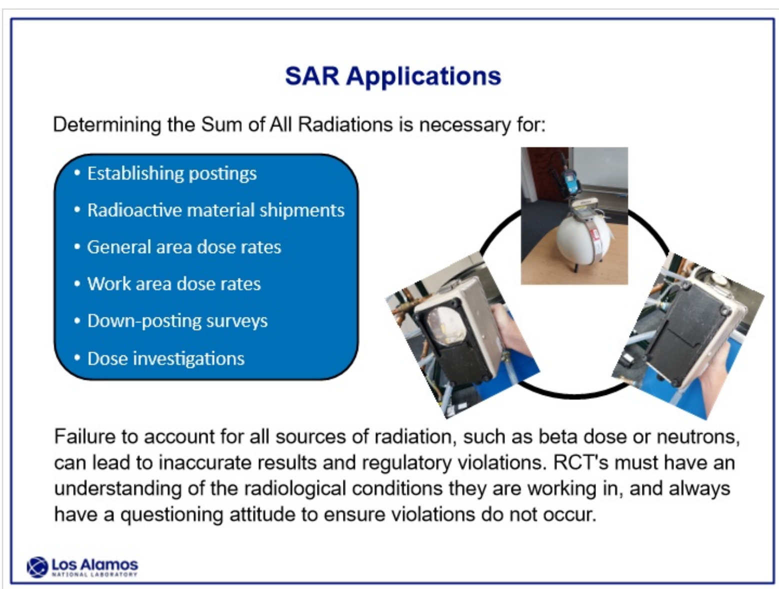
2.14 OW/CW < 1.2 Example



2.15 OW/CW > 1.2 Example



2.16 SAR Applications



2.17 Radiation Limits of Concern

Radiation Limits of Concern

The Sum of All Radiations is used for posting classifications at LANL. Table 7-3 in P121 lists the criteria for posting external radiation hazards, as shown here.

Area	Criteria
Radiation Area	$\geq$ 5 mrem/hr – < 100 mrem/hr @ 30 cm
High Radiation Area (Caution)	$\geq$ 100 mrem/hr – < 1,000 mrem/hr @ 30 cm
High Radiation Area (Danger)	$\geq$ 1,000 mrem/hr @ 30 cm
Very High Radiation Area	> 500 rad/hr @ 100 cm

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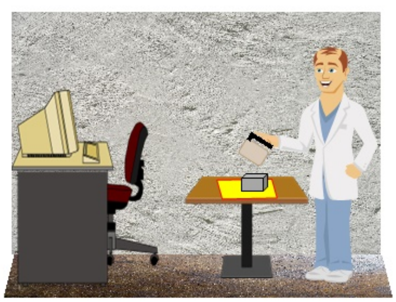
2.18 Knowledge Check

(Multiple Choice, 0 points, unlimited attempts permitted)

A radiation survey is performed on an object. The readings are 25 mR/hr at 30 cm open window, 19 mR/hr at 30 cm closed window, and 10 mrem/hr at 30 cm for neutron radiation. What is the Sum of All Radiation?

- ○ 29
- ○ 35
- ○ 15
- ◉ 44



Correct	Choice
	29

	35
	15
X	44

Feedback when correct:

That's right! You selected the correct response.

25/19 > 1.2

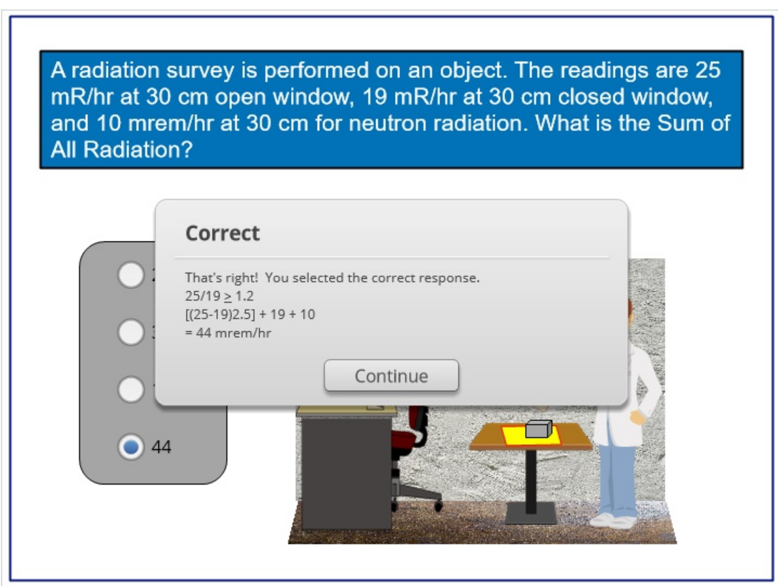
[(25-19)2.5] + 19 + 10

= 44 mrem/hr

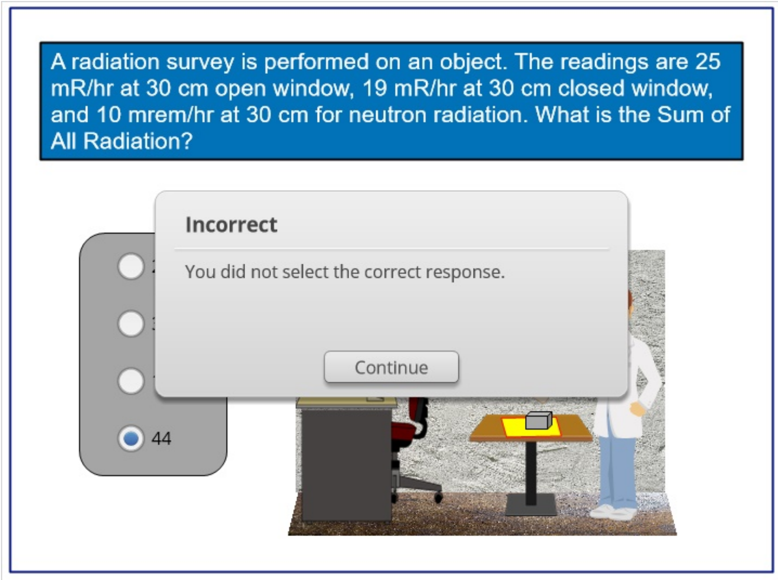
Feedback when incorrect:

You did not select the correct response.

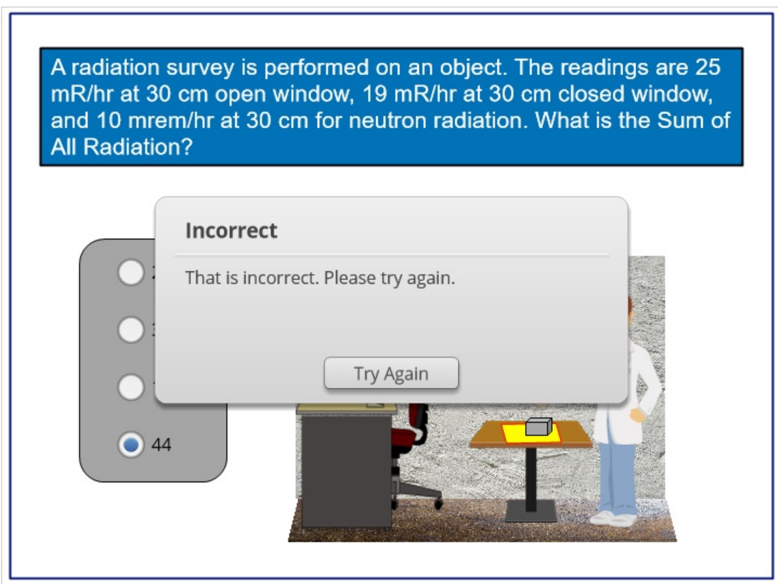
Correct (Slide Layer)



Incorrect (Slide Layer)

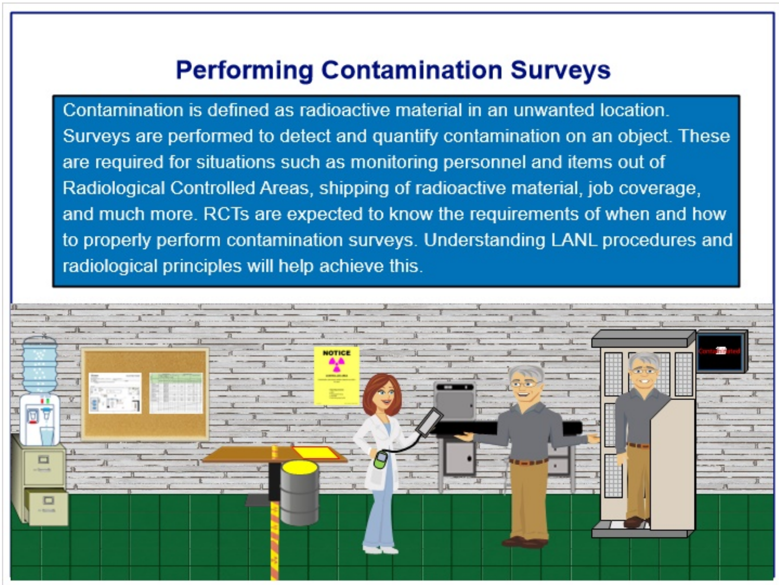


Try Again (Slide Layer)

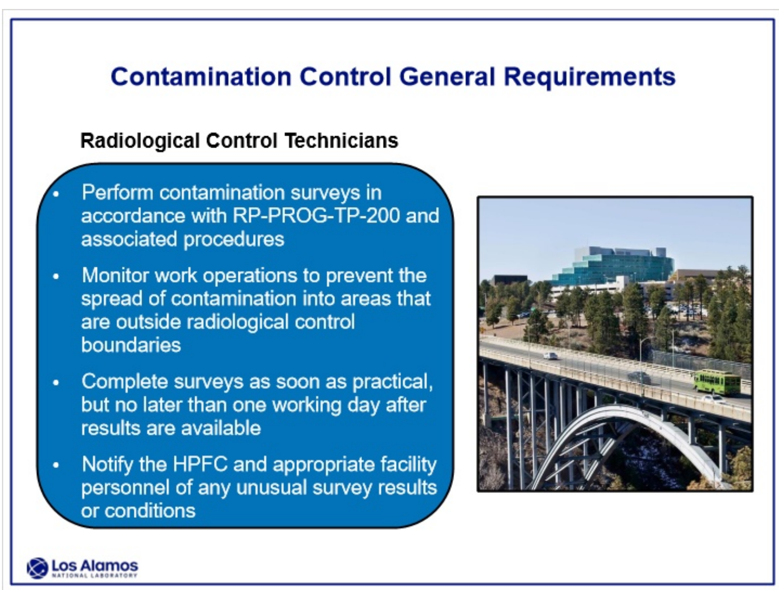


3. Contamination Surveys

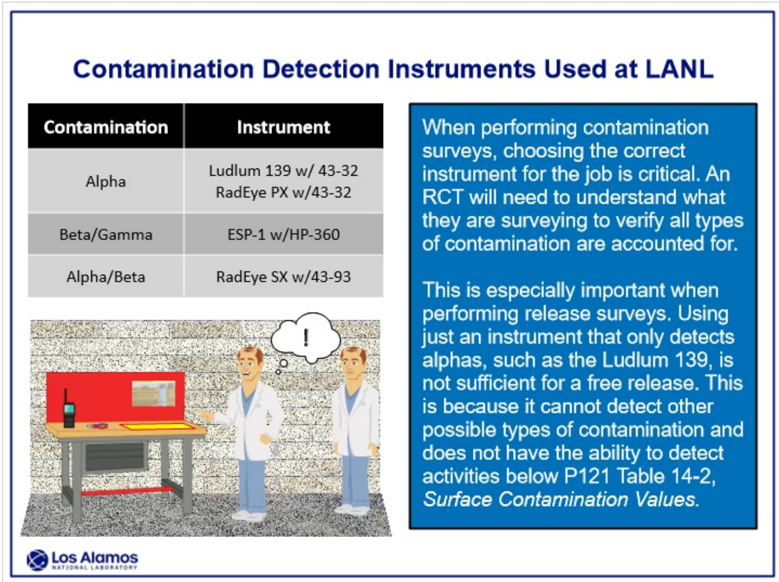
3.1 Performing Contamination Surveys



3.2 Contamination Control General Requirements



3.3 Contamination Instruments Used at LANL



Contamination	Instrument
Alpha	Ludlum 139 w/ 43-32 RadEye PX w/43-32
Beta/Gamma	ESP-1 w/HP-360
Alpha/Beta	RadEye SX w/43-93

3.4 Surface Contamination Values

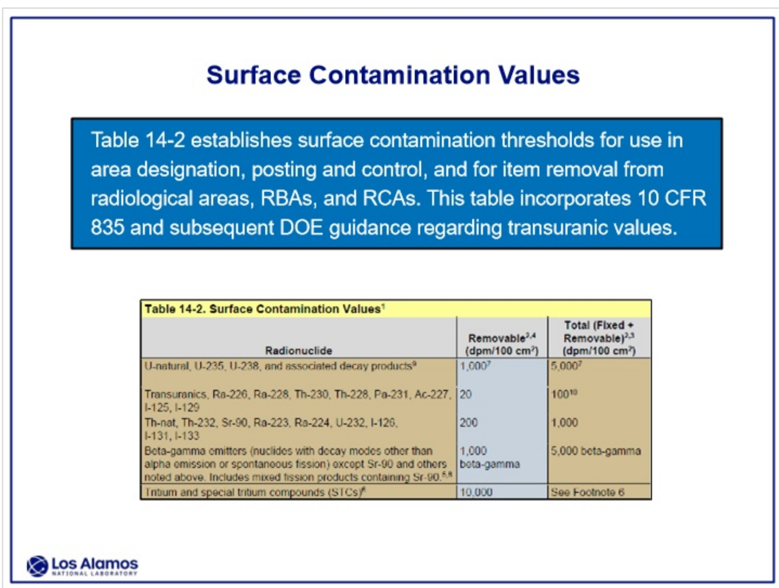
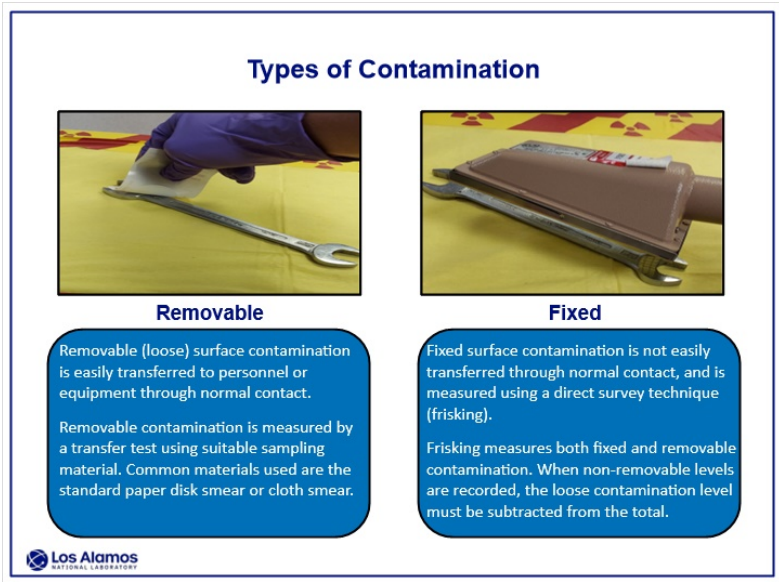


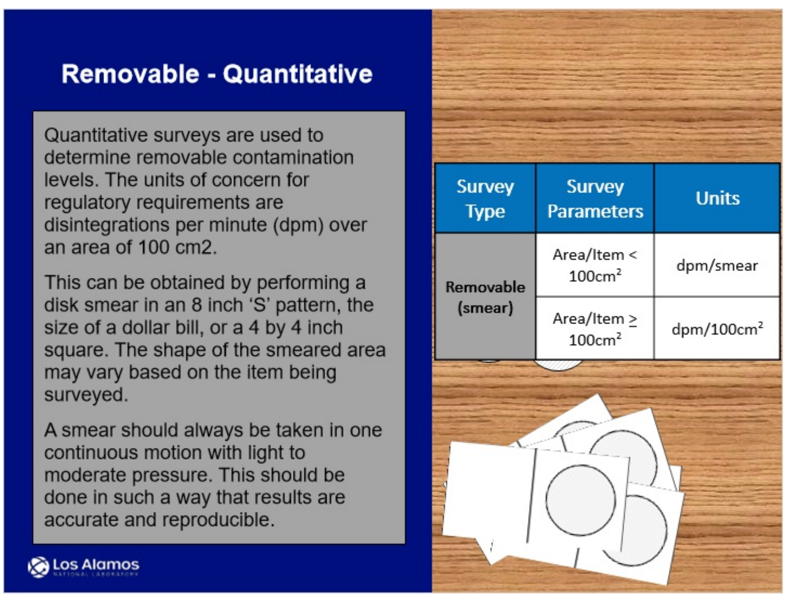
Table 14-2. Surface Contamination Values[1]

Radionuclide	Removable[2,4] (dpm/100 cm^2)	Total (Fixed + Removable)[2,3] (dpm/100 cm^2)
U-natural, U-235, U-238, and associated decay products[9]	1,000[7]	5,000[7]
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	20	100[10]
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	200	1,000
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above. Includes mixed fission products containing Sr-90.[5,8]	1,000 beta-gamma	5,000 beta-gamma
Tritium and special tritium compounds (STCs)[6]	10,000	See Footnote 6

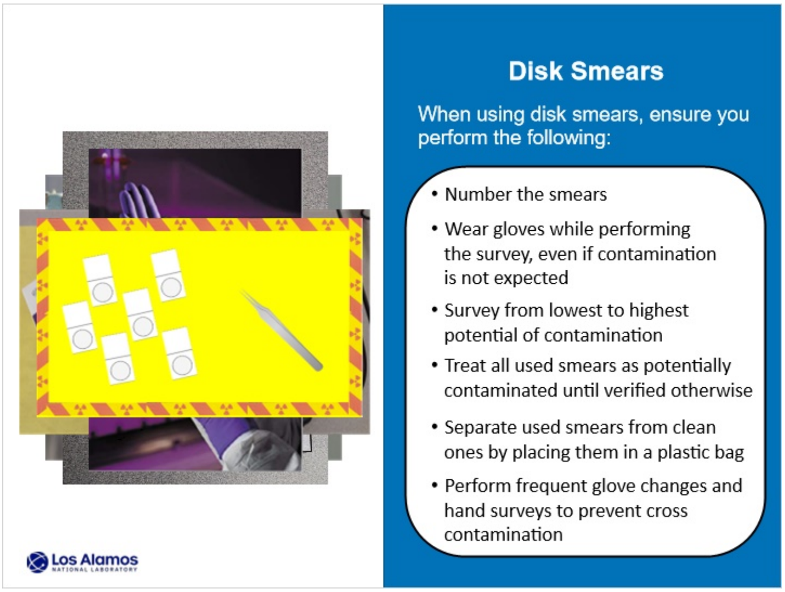
3.5 Types of Contamination



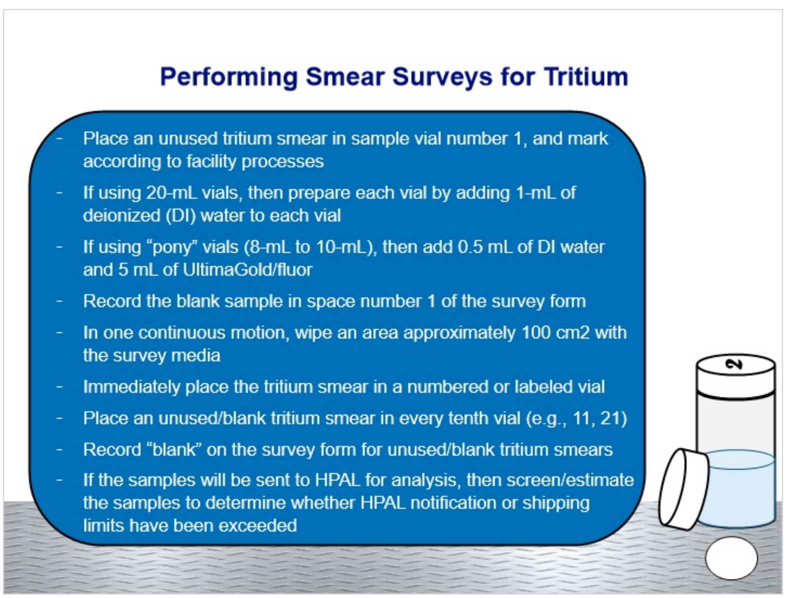
3.6 Removable - Quantitative



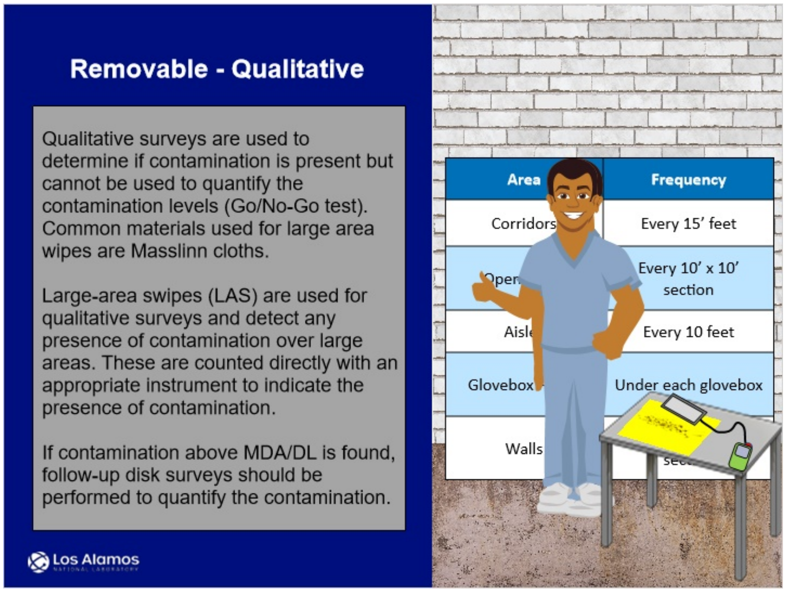
3.7 Disk Smears



3.8 Tritium Smears

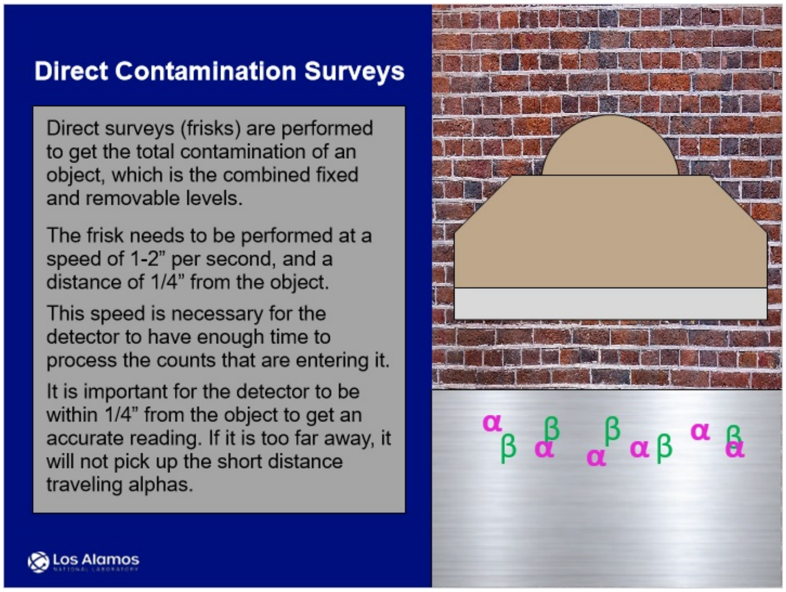


3.9 Removable - Qualitative



3.10 Large Area Smears

3.11 Direct Contamination Surveys



3.12 Units for Direct Frisking

Units for Direct Frisking

Survey Type	Survey Parameters	Units
Direct (frisk)	Detector < 100cm2 AND area of contamination < detector area	dpm/100cm2 (no area correction required
	Detector < 100cm2 AND area of contamination ≥ 100cm2	dpm/100cm2 (with area correction)
	Detector = 100cm2	dpm/100cm2 (no area correction required

Direct frisks are recorded in dpm/100cm2. As shown in the chart above, there will be times when the detector is smaller than 100cm2. In order to account for this, a probe area correction factor will need to be used.

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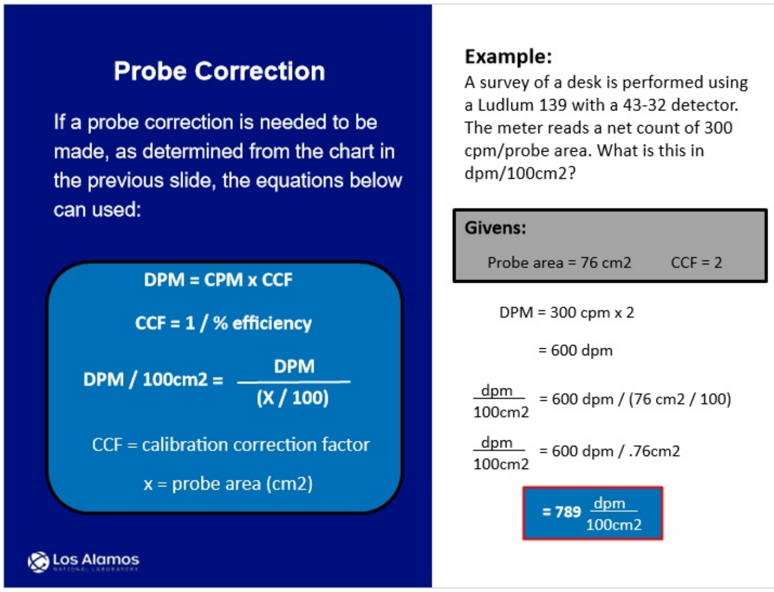
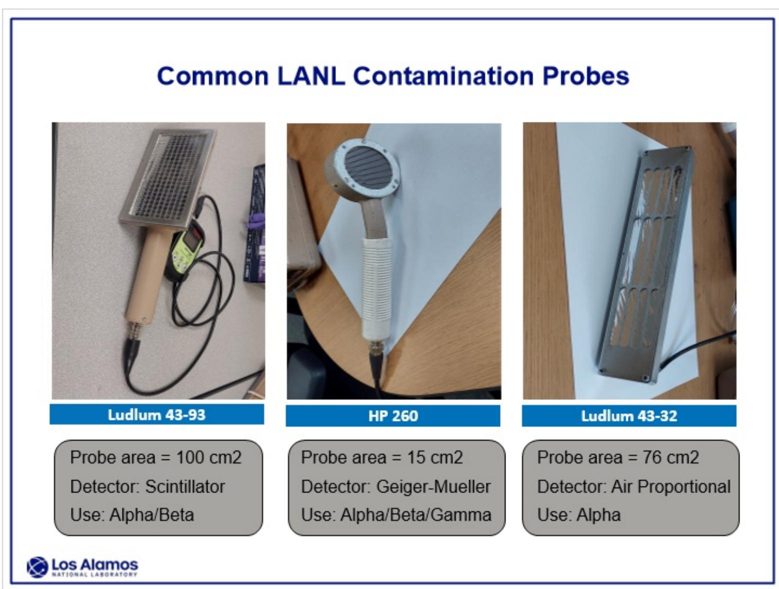
3.13 Probe Correction

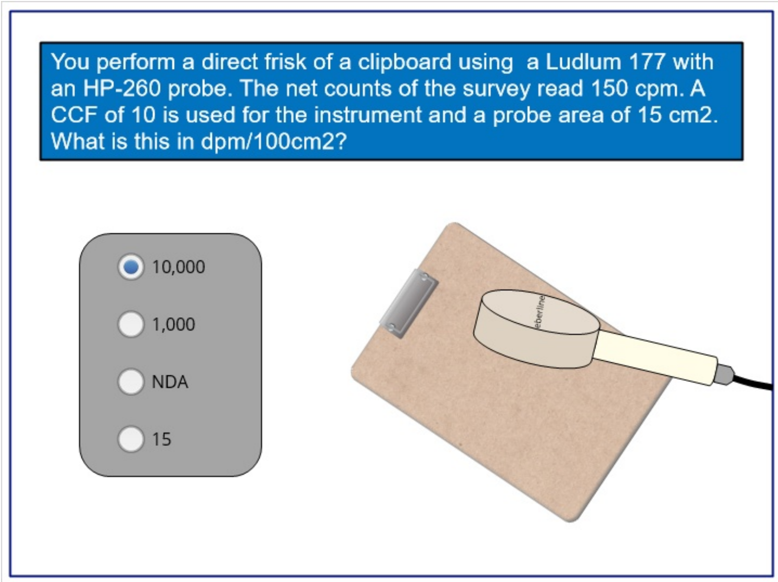


3.14 Common LANL Contamination Probes



3.15 Knowledge Check

(Multiple Choice, 0 points, unlimited attempts permitted)



Correct	Choice
X	10,000
	1,000
	NDA
	15

Feedback when correct:

That's right!

150 cpm x 10 = 1500 dpm

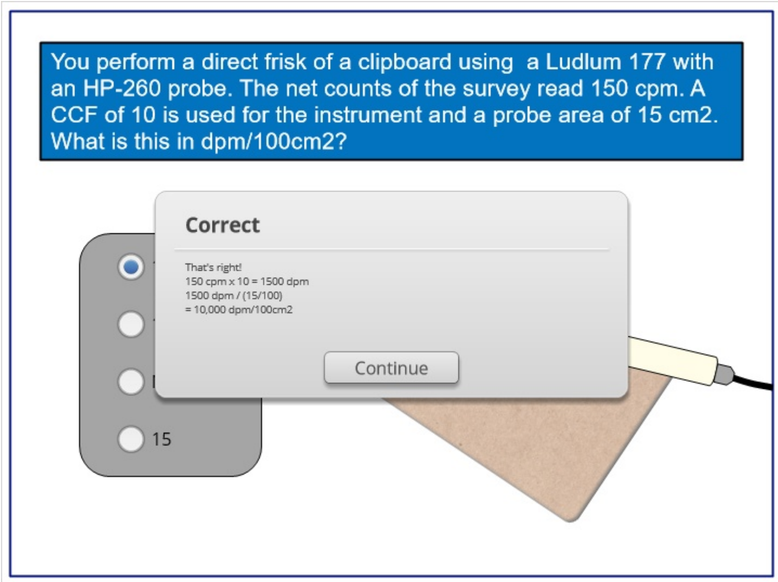
1500 dpm / (15/100)

= 10,000 dpm/100cm2

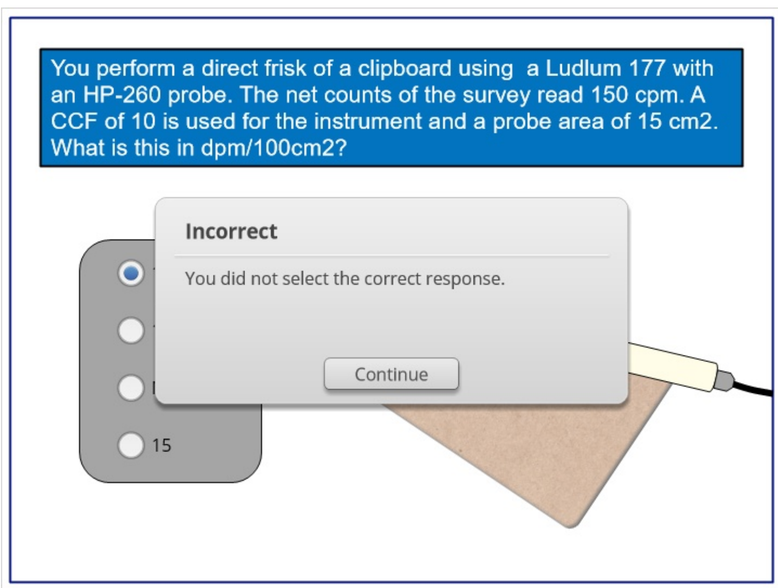
Feedback when incorrect:

You did not select the correct response.

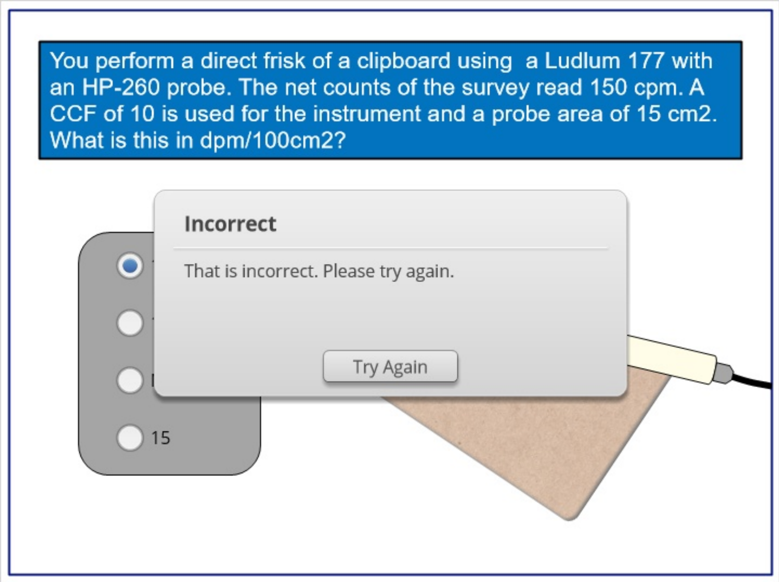
Correct (Slide Layer)



Incorrect (Slide Layer)



Try Again (Slide Layer)



3.16 Contamination Survey Instructions

Contamination Survey Instructions

RP-PROG-TP-200, Section 1411.1.1

— If the area is contaminated, then make appropriate notifications to the HPFC and facility management.

[a] Help determine whether the area needs to be decontaminated.

[b] After the area is decontaminated, re-survey the area, and evaluate the results to verify successful decontamination.

— If an instrument has an audible feature, then the audible feature must be used.

NOTE: Headsets facilitate the use of audible features in high noise areas

— Treat all used smears as potentially contaminated until verified otherwise.

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3.17 Contamination Survey Instructions continued

Contamination Survey Instructions continued.

— If performing direct and removable contamination surveys together, then perform the direct surveys before the removable.

— Contamination surveys are performed with dry media, even when used on wet surfaces.

CAUTION - All smears must be dry before being counted, except in certain cases for tritium smears

— Releasing an area or facility from contamination or airborne radioactivity status to radiologically controlled area status requires that the area be thoroughly surveyed by radiological control personnel. Contamination must be less than the limits specified in P121 Table 14-2.

— Areas released from contamination status must be decontaminated to a level as far below the allowable release limits as practical.

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3.18 Contamination Survey Best Practices

Contamination Survey Best Practices

RP-PROG-TP-200, Section 1411.1.2

— If the contamination type is unknown, then contact an HPFC for guidance on selecting the proper instrument and surveying techniques.

— The following must be considered when performing contamination surveys:

- Characteristics of the radiation hazards
- Size of the area or facility
- Operations conducted in the area
- Potential for contamination
- Ventilation flow patterns
- Contamination history

— Contamination surveys should include enough points to adequately characterize the area being surveyed.

— Contamination surveys should be performed before, during, and at the completion of work, or at any time when a radiological condition change is likely to occur.

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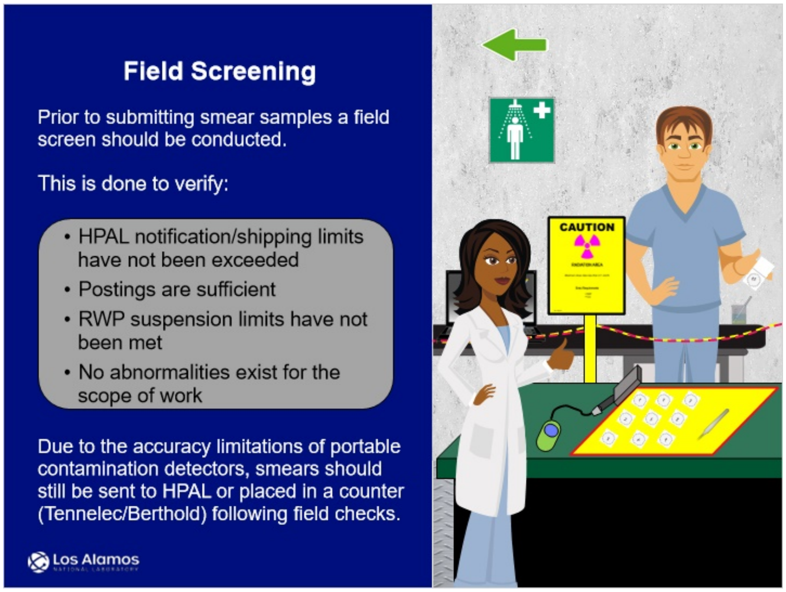
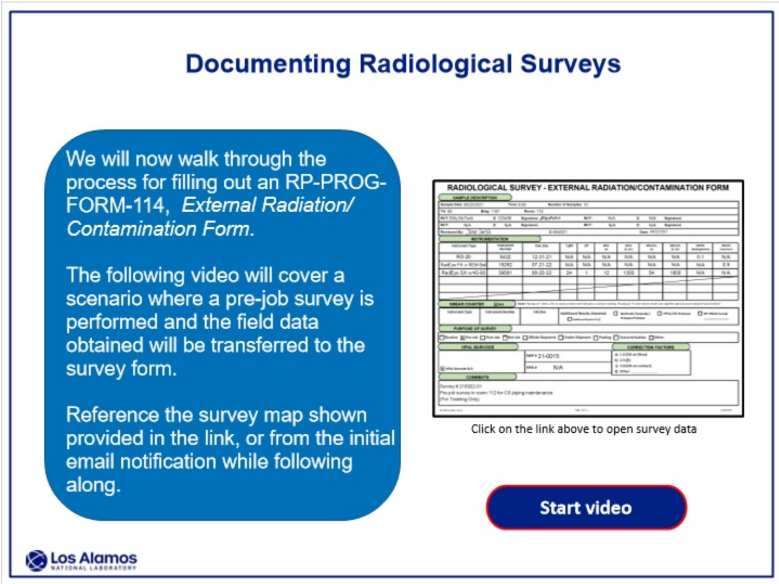
3.19 Field Screening



4. Documenting Radiological Surveys

4.1 Documenting Radiological Surveys



Notes:

4.2 Filling out an RP-PROG-FORM-114